

System Requirements for a Deep Space Optical Transceiver

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ABSTRACT

The functional requirements and design drivers for an Optical Communications subsystem are assessed based on the system requirements imposed by a proposed Europa Orbiter mission. Unlike near-Earth optical communications systems, deep space missions impose a unique set of requirements that drives the subsystem design. Significant challenges on laser efficiency, thermal control, pointing and tracking, stray/scatter light control, and subsystem mass/power need to be addressed for a successful subsystem implementation. The baseline design concept for a lasercom subsystem for the Europa orbiter mission employs a 30-cm diameter, diffraction-limited telescope, and a diode pumped solid state laser operating at $1.06\text{ }\mu\text{m}$ to support downlink communications. The baseline pointing and tracking approach is to perform Earth Image tracking with occasional calibration using the Earth-moon or Earth-star images. At high phase angles when the Earth image does not provide sufficient brightness for high rate tracking, inertial sensors (accelerometers) measurements are used to propagate the knowledge of the optical boresight at a higher rate in between celestial reference updates. Additionally, uplink beacon tracking will be used to support pointing at short range and near solar opposition when Earth image alone does not provide sufficient signal power for tracking.